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92000000323700A702800000000050307PCTKR2004000729

[별지 제65호의55 서식]

【서류명】 의견제출서 Submission of Argument

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【사건의 표시】

【국제출원번호】 PCT/KR2004/000729

【국제출원일】 2004.03.30

【우선일】 2003.07.21

【출원인】

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【전화번호】 02-553-7770

【FAX번호】 02-558-7770

【대리인코드】 9-2000-000323-7

【요구일자】 2004.07.08

【취지】 특허법시행규칙 제106조의40제5항의 규정에 의하여 위와 같이 제출합니다.

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【첨부서류】 1.의견서_2통

2.위임장_1통

1. Introduction

The written Opinion of the International Searching Authority (ISA) says that claim 1, claims 8 to 10, claims 12 to 17 lack the inventive step because these claims are obvious over Japanese unexamined patent publication No. s08-43605 (hereinafter, referred to as "D1") and US Patent No. 6,033,766 (hereinafter, referred to as "D2").

In response to the written opinion of the ISA, the applicants made amendments to the description and claims by which original claims 1 to 10 and 16 to 18 were cancelled and amended claims 11 to 15 became dependent claims referring to amended claim 10. Accordingly, if amended claim 10 has the inventive step, The inventive step of claims 11 to 15 should be also admitted. Therefore, this written reply will focus on amended claim 10 only. Hereinafter, the invention of claim 10 will be referred to as "the present invention".

2. Comparing the present invention with D1 and D2

The International Search Report and the Written Opinion of the ISA say that the present invention relates to an image sensor having optical path conversion elements whose incident surfaces have different tangent line gradients but an optical device having wedge shape elements with different tilts is disclosed in the D1 and D2, and thus, the present invention is obvious over the D1 and D2.

(1) The present invention recognizes that a conventional image sensor has a problem that light is incident thereon at different inclination angles according to distances from the center of the image sensor but the D1 and D2 have no relation to this point of view.

In a conventional image sensor, image captured at the peripheral area is darker than at the central area. In the serious case, no image is captured on the peripheral area.

The reason of this problem is that light is incident on the central area parallel with an optical axis at no inclination angle but light is slantingly incident on the peripheral area at a large inclination angle.

Therefore, the present invention intends to counterbalance the inclination angle of light incident on the peripheral area.

However, the cited inventions, D1 and D2, have no relation to this. For example, in Fig. 10A of the D2, tangent line gradient value of the incident surface of the lens is designed on the assumption that light is incident on the whole area of the optical device parallel with an optical axis at no inclination angle.

(2) The gist of the present invention is not just that tangent line gradient values of corresponding parts of the incident surfaces of the optical path conversion elements are different from one another but how much tangent line gradient values thereof are.

According to amended claim 10, the gist of the present invention is to design the incident surface of each optical path conversion element to have a tangent line gradient value to convert the optical path of light incident slantingly on the peripheral area of the image sensor to be identical with that of light incident vertically on the central area of the image sensor to counterbalance the inclination angle of light incident on the peripheral area of the image sensor. That is, the gist of the present invention is to make the inclination angle of the incident light counterbalanced by the tangent line gradient value determined according to the refraction law or the reflection law.

The inclination angle of the incident light on the optical path conversion element depends on the distance from the center of the image sensor and thus, the tangent line gradient values of the corresponding parts of the respective optical path conversion elements are different from one another according to the distances between the corresponding parts and the center of the image sensor.

Here, the corresponding parts indicate parts at an identical distance from the respective matching photoelectric elements. That is, the respective photoelectric elements function as the origin in deciding where the corresponding parts are.

Of course, the present invention is similar to the cited inventions in that the corresponding parts of the elements have different tangent line gradient values, which is pointed out by the ISA. However, that is nothing but a result caused when the elements are designed to have the tangent line gradient values claimed in the present invention.

A distinction between the present invention and the cited invention can be clearly understood from Fig. 6 and Fig. 7, the conventional arts cited in the description of the present application. In the conventional image sensors of Fig. 6 and Fig. 7, corresponding parts of micro lenses have different tangent line gradients from one another but nevertheless condensation efficiency at the peripheral area of the image sensor is still bad.

Compared with the D1, the image sensor of Fig. 6 corresponds to an optical device having wedge shape elements with different heights described in the D1 and the image sensor of Fig. 7 corresponds to optical devices of Figs. 3(d) and 4(d) of the D1 having wedge shape elements with different pitches.

In the image sensors of Figs. 6 and 7, there is a problem that an image captured at the

peripheral area is darker than at the central area.

The D1 and D2 relate just to a fabrication method and a transfer method and teach just that elements with various shapes can be easily made by using their methods. However, the D1 and D2 never say what shapes of those elements are in quantitative terms, that is, how much tangent line gradient values of those elements are.

(3) The object of the present invention is to efficiently condense light passing thorough the optical path conversion elements onto the respective matching photoelectric elements, while in the cited inventions there is not a matching relation between the wedge shape elements and the photoelectric elements.

The present invention condenses light whose optical path has been converted by the optical path conversion elements onto the respective matching photoelectric elements. That is, there is a relationship that one optical path conversion element corresponds to one related photoelectric element.

However, a fresnel lens of Fig. 3(d) and claim 8 and a cylinder fresnel lens of Fig. 4(d) and claim 9 of the D1 and a zone plate lens of Fig. 10A of the D2 condense the incident light onto a single focus ('P' in Fig. 10A of the D2). Accordingly, the cited inventions are based on the wholly different basis from the present invention condensing the incident light onto a plurality of photoelectric elements respectively.

Each element of the fresnel lens in Fig. 3(d) of the D1 and the zone plate lens in Fig. 10A of the D2 has a ring shape in a top plan view and each element of the cylinder fresnel lens in Fig. 4(d) of the D1 has a narrow band shape in a top plan view, while each optical path conversion element of Figs. 13 and 19 in the present invention has an aspheric micro lens shape or an aspheric micro reflecting mirror shape in a perspective view.

(4) If an image sensor employs the structure disclosed in the cited inventions, an image captured at the peripheral area of that image sensor is much more darkened.

The above-mentioned differences between the present invention and the cited inventions can be summarized by the following question.

"When an image sensor employs the elements of Figs. 3(d) and 4(d) in the D1 and Fig. 10A in the D2 as the optical path conversion elements, can light be delivered onto the peripheral area of that image sensor?"

The answer to the above question is "rarely", because the fresnel lens basically condenses light onto the focus ('P' in the Fig. 10A of the D2).

3. Conclusion

As mentioned above, the technical basis of the cited inventions is fundamentally different from that of the present invention and thus, the written opinion of the ISA that the present invention is obvious over the cited inventions is unreasonable. Accordingly, we consider that the present invention has to be admitted to have patentability.